## Stable Mixed-Conducting Bilayer Membranes for Direct Conversion of Methane to Syngas

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Results on the oxygen permeability and stability of perovskite-type $La_{0.6}Sr_{0.4}Co_{0.8}Fe_{0.2}O_3$ (LSCF) coated with $(Sm_2O_3)_{0.1}(CeO_2)_{0.9}$ (SDC) are presented. Bilayer structures were formed by depositing a thin layer of SDC by pulsed laser deposition (PLD) on the reducing side of the membrane. Oxygen permeation fluxes measured with $N_2$-$O_2$ mixtures on the feed side and He-$CH_4$ mixtures on the sweep or reducing side are compared with non-coated results. With the introduction of $CH_4$ into the He sweep, non-coated samples exhibit very high oxygen flux values but degrade rapidly as the membrane decomposes to less conductive phases. In contrast, coated membranes under similar conditions show superior stability and increased oxygen flux over a period of greater than 100 hours. During reaction runs with $CH_4$, a cyclic redox reaction with respect to ceria was observed and is believed to be due to oscillations in the $P_{O2}$ at the SDC-gas interface. The cycling phenomenon is discussed and tested as a function of $P_{O2}$ and temperature.